STUDY OF TIME LAPSE PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS

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TYPE I PROGRESS REPORT

A) Title: STUDY OF TIME-LAPSE DATA PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS

ERTS-A PROPOSAL 342-B

B) GSFC ID PR154

C) Problems Impeding Progress - None

D) Accomplishments

1. During Reporting Period

(a) Equipment

Design of the semiconductor scratchpad memory (for revisable thematic masks) was completed. Construction is in progress.

(b) Data Measurements

1. For Dr. Mark F. Meier (INO45) U.S. Geological Survey

Survey, Tacoma, Washington:

No additional measurements were made beyond those reported in the Type I Progress Report, dated 6 May 1973. On the 8th of June, Messrs. W. Evans and S. M. Serebreny of SRI visited Dr. Meier and staff at Tacoma at which time discussions were held about many aspects of snow measurements from ERTS imagery over mountainous terrain. Particular attention was given to questions of ground truth and of measurement variances.

In our Progress Report for the previous reporting period (6 March - 6 May 1973) curves were presented which related measured

snow area to image gray step (radiance) values. Also indicated were the reading variances noted between operators and for different evaluation criteria by the same operator. These variances typically amounted to about ±50 km^2 for a snowfield area of 400 km^2, or ±12.5% of the reading. It would be desirable to reduce these variances. We also need to know whether any systematic bias exists between ERTS/ESIAC measurements and other procedures for measuring the snow area.

The best source of ground truth data currently available for the test area appears to be U2 imagery of Mt. Rainier photographed on 10 August 1972. A small-scale print (approximately 1:100,000) from this scene was reviewed at the meeting in the presence of those who know the mountain well. Agreement was reached that U2 imagery would be satisfactory for this purpose. Currently, additional details of the scene are being studied at SRI in color and color stereo. It is felt that this study will enable the writing of more definitive rules about how to set the slicing threshold when measuring ERTS images on the ESIAC.

The concept of estimating snowpack by assigning an Equivalent Snow Elevation has gained some acceptance in snow hydrology, and detailed tables of area versus elevation are already available for some areas. Several procedural alternatives are available for using the ESIAC to estimate Equivalent Snow Elevations, and at the meeting it was agreed to spend some time experimenting with these alternatives.

2. For Dr. Raymond M. Turner (IN-411) U.S. Geological Survey, Tucson, Arizona: Dr. Turner visited SRI during the week of 14 May and used the ESIAC to study his imagery of desert vegetation for the Tucson area. Registered color sequences for ten available ERTS cycles were prepared for two major test regions designated as Avra Valley and Old Baldy.

In order to provide a quantitative means of specifying vegetated areas that is reasonably independent of illumination variables due to seasonal and local variations in sun angle, a procedure was evolved for deriving thematic masks in accordance with the ratio of radiances observed in MSS band 6 to those observed in band 5. Areas having near 100% coverage of healthy vegetation are characterized by high band 6/band 5 ratios, on the order of 3 to 6, or even more. Bare desert soil exhibits a ratio very close to unity. It was found that the typically sparse vegetative cover of interest to Dr. Turner increases this bare desert ratio only slightly--to about 1.2. However, with reasonable care in compensating for film density variations during the process of scanning with the ESIAC, it has proven feasible to generate thematic masks which are TRUE for all areas where the radiance ratio exceeds threshold values as small as 1.1 or 1.2.

The ability to skip rapidly back and forth through registered false-color sequences was of great help in arriving at an acceptable threshold for the ratio. To facilitate further checking against ground truth, and to provide documentation for the work, a set of registered images, overlays, and radiance profiles was prepared by photographing the ESIAC displays. A typical set of data provided to Dr. Turner included the following items:

1) Scenc Photo
2) Scale (Kilometer) Grids
3) Transect Overlay
4) Calibrated radiance profile
5) Ratio Overlays (Diazo Transparencies)
6) Area measurements for the ratio overlays.

3. For Mr. G. E. Coker, U.S. Geological Survey, Water Resources Division, Tampa, Florida:

Mr. C. E. Coker visited SRI from June 4 through June 8, 1973, inclusive. The initial part of the visit was spent in demonstration of ESIAC and experimenting with procedures offering the best possibility for detecting water changes over the Everglades. Only three cycles (11, 12 and 13) were available and of these, cycle 11 was 50 per cent cloud covered. However, all three cycles were entered into the ESIAC and color displays were made of various band combinations. The decision was made that a combination of Band 5 in Cyan with Band 7 in Red offered the best choice for detection of water changes. However, for these particular scenes, Band 7, by itself, was almost as good.

Radiance profiles were recorded on four transects in conservation area #1 (upper part of Everglades) for each of the cycles. The water change was observed both by time-lapse and by displaying date-to-date difference images. Numerous photographs were taken of the displays.

2. Planned for Next Reporting Period

Continued data processing for Dr. M. F. Meier, to wit:

A. Study the time sequence of snow lines in the North Cascade region, pecifically Basin 1755, 1330 and Mt. Rainier (all of which are vegetated areas) and one basin in Alaska, still to be selected, that is a non-vegetated area.

B. Use all of the previous results obtained by ESIAC to determine the accuracy with which snow can be measured considering the effects of seasonal changes and surface conditions upon snow appearance, and/or spectral response.

In addition some attention will be devoted to the problems of using ESIAC to study glaciers, i.e., their shape and dimension, changes in size (especially edges), terminal moraines, glacial surges and also the extent and changes of snow on the glacier. Both advantages and disadvantages of using the electronic system (ESIAC) for these purposes are to be delineated. [In creating time sequences of glacier changes, the Hubbard Glacier will be used plus those other glaciers that promise useful results.]

If time permits, a meteorological analysis will be conducted primarily with respect to occurrence of snow or snow melt on the glaciers and the Alaska basin selected for measurement.

Current plans for working visits to SRI by USGS experimenters desiring additional analysis time on the ESIAC are as follows:

Dr. R. M. Turner	Week of July 16
Mr. E. F. Hollyday Ms. V. Carter	Week of August 12
Mr. F. Ruggles	Late August

The scratchpad memory is scheduled for completion by 15 September.